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Art. XIII.—*On the Processes prevailing among the Hindus, and formerly among the Egyptians, of quarrying and polishing Granite; its uses, &c.; with a few Remarks on the tendency of this Rock in India to separate by concentric exfoliation.* *By* Lieut. Newbold, F.R.S., &c., *Madras Army.*

(*Read 15th January,* 1842.)

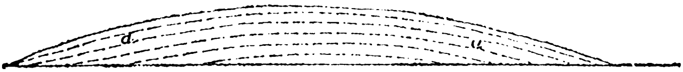
Among the Hindus of Southern India three modes of quarrying granite prevail. The first, and most common, is by the agency of fire. In this process the surface of the bare convex plateaus, or bosses, of the rock is covered with dry fuel, composed generally of bushes of the thorny Acacias common to the surrounding plains,—viz., those of the *Babul* and *Kikar*,—and proportioned in quantity according to the thickness of the slabs required. The fuel is set fire to, and suffered to burn, except in a few cases, until entirely consumed; when the subjacent rock will be found to have exfoliated in a cavo-convex flake, thinning off towards the edges, and varying in extreme thickness from six to twenty-four inches. The longer continued and more intense the heat, the deeper, in general, the line of separation. The flake is detached by driving small iron wedges underneath, and raising it with an iron lever: the separation is assisted, when the rock is refractory, by dropping a heavy boulder of greenstone or granite on its surface; or, when heated, by a sudden affusion of cold water.

Laminar Structure and Exfoliation of Granite.

It may be remarked here, that many of the granite bosses and spheroids abounding in Southern India, have a concentric laminar structure, resembling, in some measure, that of an onion; and often exhibited in weathering, when the rock exfoliates in successive layers describing segments of circles of greater or less radii, from a foot to 100 yards and upwards. It will be readily understood, that short slabs taken from the circumference of the largest bosses will present little apparent curvature: but in working downwards, the curves of the layers, towards the centre of the spheroid, become greater within a given space; and consequently the quarry is no longer capable of furnishing slabs of moderate length, having the requisite degree of straightness for the purposes to which they are usually applied.

Diagram No. 1 presents a section of a boss of granite. The dotted lines *a. a.* in it and No. 2, show the direction of the concentric layers, not visible in the unheated, or unweathered mass.

No. 1.



No. 2.

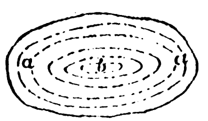


Diagram No. 2 is a section of the smaller spheroids, often seen loosely scattered over the plains, and perched on the summits of granite rocks. Those of Hydrabad have been, by some,—Brongniart and De Luc[1] among others,—erroneously supposed to be erratic blocks; but they owe their bouldered form to a process of spontaneous concentric exfoliation, which I have also observed fully developed in both the older greenstone and overlying trap rocks of India; and, in a minor degree, in some of the *trachytes* of Smyrna and Mitylene, and the older lavas of Etna and Vesuvius.

This concentric structure, it is hardly necessary to mention, has been proved,—by the ingenious experiments of the late Mr. Gregory Watt in melting 700 cwt. of the Rowley-rag basalt,—to be caused by refrigeration, under certain conditions, from a fused state. The spheroid is, perhaps, only an approximate to a more perfect form of crystallization on the large scale. In India it extends to the granitoidal or thick-bedded gneiss in contact with, and near the granite, which is also quarried in a similar manner; the laminæ exfoliate nearly horizontally, at right angles with, and totally independent of, the vertical strata of the rock. So strongly developed are these concentric lines of separation, that they often divide individual crystals of felspar across their planes of cleavage. These facts may not only be regarded as corroborative of the Huttonian hypothesis, viz., that the materials of gneiss, originally deposited from water in the usual form of aqueous strata, were subsequently altered by subterranean heat so as to assume a new texture, but still further,—that this stratified rock, from heat, has assumed the globular laminar structure of plutonic and volcanic rocks, which, in the former, often intersect at right angles the original lines of deposition, and even the cleavage planes of embedded crystals.

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[1] Tableau des Terrains, page 83.

The apparent stimuli to a development of this structure, often latent in the granite, greenstone, and granitoidal gneiss of India, are the sudden alternations of heat, moisture, and cold; assisted, probably, by electric currents excited under such conditions, and carbonic acid gas mingled with the water of springs, which abound with it.

The exfoliation of whole mountain masses, on the grand scale, by such natural causes, produces some of the most picturesque features of an Indian landscape. Hence its singular, dome-shaped, mammillary rocks, crowned with tors and logging-stones of the most fantastic forms. Many appear to the casual spectator to have been rolled up to the bare heights they occupy, and piled by some giant hand; or riven, and thrown into wild confusion by a convulsion of nature; or scattered over the plain by the torrent of a deluge.

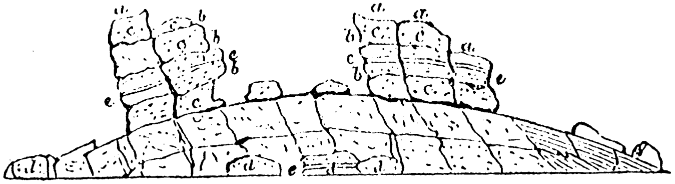
These appearances are caused by joints, nearly vertical, (*a. a. a. a.*, Diag. No. 3,) crossing at right angles the nearly horizontal concentric lines, (*b. b. b. b. b.*,) and originating, probably, in similar causes. Thus the rock is divided into rhomboidal and cuboidal masses, (*c. c. c. c.*,) resting one upon the other. In process of weathering, those on the inclined sides of the convex boss soon slide down into the plain below, forming a rugged talus at the base (*d. d. d. d.*) Some of these rock-slips, from considerable heights, are attended with a noise like thunder.

The blocks that remain piled on the less inclined surface of the summit, often retain their isolated position, resembling the ruins of some Cyclopean structure; but in course of time, either overbalanced by their own weight, or by splitting, or exfoliation of the rock beneath them, they lose their equilibrium, and are precipitated to the base.

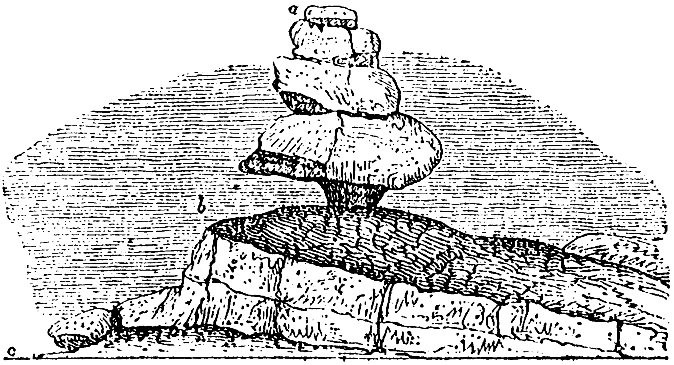
Solitary columnar piles (Diag. No. 4) are frequently left standing on bare elevated plateaus of rock, held together by a cement resulting from their own detritus, and washed by the rains into the joints and seams. That these blocks once formed one continuous mass with the adjoining rocks is evident from the dip and direction of the lines of exfoliation, (*b. b. b. b. b.*, Diag. No. 3,) and from those of veins passing through the whole series (*e. e. e. e. e. e.*, Diag. No. 3). Such is the nature of the process by which the granitic mountains of India are slowly, though surely, crumbling into dust, which, diffused by the action of the rains, and the springs that have assisted in the disintegration of the rock, is gradually blended with, and lost in, the soil of the surrounding plain.

Diagram No. 3 is taken from the granite rocks near Bayagudda, on the N.W. frontier of Mysore; and No. 4 from a pile of granite near Bellary, twenty-eight feet high from *a* to *b*, and about forty feet from *a* to *c*. I regret not having my friend Lieut. Lawford's clever sketch of this singular pile to present to the Society, in lieu of my own rude scratch below.

No. 3.



No. 4.



Second Process of quarrying Granite.

The first process of quarrying granite, just described, is resorted to when stone is required for ordinary building purposes. For statuary, mill-stones, and for other blocks of given dimensions, and of a greater thickness than one or two feet, the Hindus have recourse to another method, without applying heat, and precisely similar to that of the ancient Egyptians in quarrying the granite of Syene, since the action of fire renders the stone liable to split and scale in working, and as its effects are little under control. Chains of small holes, about an inch square, of different depths, from an inch upwards, according to the thickness of the block required, are cut at short intervals in the requisite directions by means of small chisels with highly tempered points. While working the holes, water is poured into them to preserve the temper of the chisel by keeping it cool, and to facilitate the cutting of the stone. The liability of iron instruments employed in the working of granite to become blunt by the action of heat, is thus noticed by Sir R. Westmacott[1]. "Granite, as most materials of that nature, being generally worked with a pick of various strength, until reduced to a surface, the duration of the tool depends upon its form; the more obtuse, the longer it will work, remaining longer cold. In *jumping* (as it is termed) holes for the admission of bolts into fractured parts of granite, the tools are usually of strong tempered iron, about three-quarters of an inch in diameter, which resist the heat sometimes half an hour, seldom longer. One man holds, and turns, or moves the tool, whilst the other strikes it with a heavy hammer, the hole being supplied with water. Tools of less diameter are formed of steel; but these will not resist more than 300 strokes, when the points fly, and require to be fresh battered. Sculptors generally use tools formed of blistered steel, or of cast steel, the finer sort highly tempered by immersing them, when heated to a proper degree, into cold water." Thus it appears that the effects of heat in blunting iron tools employed in the working of granite are not only known to the Hindus, but that their mode of remedying the evil is identically the same as that in practice among the enlightened sculptors of Europe. The former effect the separation of the block by gentle, continued, and simultaneous striking on a number of iron wedges inserted into the holes just described[2]. Large detached masses of granite and greenstone are readily split asunder by a modification of this process, the antiquity of which is proved by the chisel marks still visible in the ancient quarries. Those in the granite rocks around the ruins of the ancient Hindu city of Bijanugger, whence were hewn the large blocks seen in the Cyclopean masonry of its walls and temples, and composing some colossal monolith statues, are perfectly as fresh and sharp as though cut only a year ago.

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[1] SIR GARDNER WILKINSON'S *Ancient Egyptians*, 1st Series, Vol. III., p. 250. Note.

[2] Major Wheeler informs me, that in one instance he observed the natives pour water into the opening effected by the wedges, immediately after the stone had begun to give way. He then put his ear close to it, and heard the noise of the stone opening: a few more knocks on the wedges were sufficient to effect the separation.

Third Process.

There is still another process resorted to by the *Wudras*, or native quarriers, of Southern India for obtaining long thin flags to cover over small bridges, for pavements, lintels, posts for vine trellises, and other purposes for which more exactness of shape and size is necessary than in the slabs separated by the first method. In the third, the principles of the other processes are combined. The rock is heated by fire, holes are then cut about an inch and a half asunder, and about two inches deep, and the block detached in the manner described in the second process. The first is usually applied to thick-bedded gneiss, and the laminar, large-grained, crystalline, micaceous granite; the second to the more compact, hornblendic, and close-grained; and the third to an intermediate variety, from which I have seen blocks eighty feet long separated.

My friend Lieut. Lawford, of the Madras Engineers, informs me that the native quarriers of Bellary do not profess themselves capable of judging of the quality of the granite by the eye, but by its sound when struck,—the more sonorous varieties being found the hardest, and most infissile,—a phenomenon readily understood. They are also aware of the calorific action of the solar rays on the rock, in assisting the process of its separation, and usually select the hot season for their operations; partly for this reason, and partly to avoid the inconveniences of working during the monsoon. I found the temperature of a granite boss at Dewanconda, in the Ceded Districts, in June, 1839, at 3 P.M., 120.5° Fahrenheit; while that of the air in the sun was only 100°, and in the shade 95.5°. Temperature of rock at midnight, 86.5°; temperature of air, 79.5°. Humboldt notices the great degree of warmth retained during the night by the granitic rocks of South America, which was found to be 85.5°, while that of the air was 78.8°. In the day their temperature was 118.4°; and the heat they emitted, he describes to have been stifling.

The more laminar varieties of the granite and thick-bedded gneiss, in the vicinity of Bellary, may be separated into layers thin enough for the purposes of tiling. According to Lieut. Lawford, the ordinary sized granite building slabs are there sold at 500, and 700, per rupee; the largest sized, 1000 per 3½ rupees. Flags, 1½ ft. square, and from 4 to 9 inches thick, are 5 rupees per 100, a price exclusive of the labour of the stone-cutters. Blasting is seldom resorted to by the Hindus, though the Mohammedans of India had early recourse to it: marks of old exploded blasts are visible in the rocks of Chitteldroog, Severndroog, Cudhully, and other places in Southern India.

Egyptian mode of quarrying Granite.

Sir Gardner Wilkinson, apparently under the impression that the ordinary Hindu method of quarrying granite is by the affusion of cold water over its heated surface,—a process only occasionally resorted to in difficult cases, as previously remarked, or, when very thin slabs are required, to prevent the heat from penetrating deep into the rock,—states[1], "that some have imagined that they" (the ancient Egyptians) "used the same means now practised in India, of lighting a fire along the whole length of the mass, in the direction they intended it should split; and then, pouring water upon it, cracked the stone in that part by its sudden action: but this is very doubtful, and the presence of the holes for the wedges sufficiently proves the method they usually employed." Now it appears that the usual Egyptian mode of cutting large blocks from the quarries "by a number of metal wedges, which were struck at the same instant along its whole length," is identical with the Hindu process, No. 2, described at pp. 4, 5, and 6. The troughs described by Sir G. Wilkinson, as frequently found along the whole line of holes where the wedges were inserted, and as affording strong argument in favour of his opinion that the rock was sometimes split by the expansion of wedges of highly dried wood being driven into the holes, and then saturated with water, seem rather to have been intended to facilitate the splitting of the granite in the proper direction. It is possible that, like the Hindus, the ancient Egyptians were not ignorant of the effects of cold water in preserving the edges of their chisels in punching the holes; and that the troughs might have been intended to convey a stream of water to the whole line. They were acquainted with the use of fire in splitting rocks, as is evident from a fragment by Agatharcides on the Red Sea, wherein he mentions that the hard rocks of the gold mines of Egypt were cloven by heating them with burning wood before the application of iron tools.

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[1] *Ancient Egyptians*, 1st Series, Vol. III., pp. 337 and 338.

Tools used by Hindus in quarrying Granite.

The tools used by the Hindus are chisels, hammers, wedges, and levers. The chisels are usually small and pencil-shaped, of steel, or of iron with highly tempered points. The wedges and levers are of iron; the former square, tapering slightly, and from two to three and a half inches long, varying in thickness. My friend Lieut. Smythe, of the Madras Engineers, informs me that the wedges he has seen employed were not more than two and a half or three inches in length, and about three quarters of an inch square, with top a little more than an inch square; bottom slightly smaller than the top. The hammers used were of wood. Iron hammers are also employed, on the striking face of which is a hollow filled with lead, or a piece of soft iron,—a contrivance which not only tends to preserve the edge of the chisel in working, by diminishing the vibration, but preserves the hammer also, as the lead or iron in the cavity can be replaced as often as worn out.

Tools used by the Egyptians.

It is certain that the ancient Egyptians used implements of bronze in their quarries; but much doubt has been expressed as to their employment of tools of iron and steel. Iron was known to the Greeks 188 years before the Trojan war[1], and to Tubal Cain before the deluge[2]. The Jews worked iron in the time of Moses, shortly after their return from Egypt[3]. It is hardly possible to suppose their late teachers and taskmasters, the Egyptians, confessedly skilled in the arts of metallurgy, should have been ignorant of this useful metal; or, that they could have hewn out of their quarries the numerous and prodigious blocks of the hardest granite and basalt, which still attract the wonder of the world, with no other implements than chisels of bronze, armed even with emery and corundum. It must be remarked, on the other hand, that while wedgelike tools of bronze (the λατομιδες χαλκοι of Agatharcides) are found, though rarely, in the quarries of Egypt, no iron implement has been detected, with the exception of a fragment, in the great pyramid, by Colonel Vyse and Mr. Perring; three rust-eaten pieces of a sickle, under the feet of a sphinx at Thebes, by Belzoni; and the small iron hoe deposited in the museum at Berlin. The dates of the two latter specimens are uncertain; but the first, it is proved, must have been cotemporary with the pyramid itself. As Sir G. Wilkinson justly observes[1], the butchers in the sepulchres of Thebes are represented "sharpening their knives on a round bar of metal attached to their apron; and the blue colour of the blades, and the distinction maintained between the bronze and steel weapons in the tomb of Rameses III.,—one being painted red and the other blue,—leaves little doubt that the Egyptians at an early Pharaonic age were acquainted with the use of iron;" and I fully concur in concluding, that the principal reasons for the rare discovery of iron implements among the antiquities of Egypt, are the rapid decomposition of that metal from the saline atmosphere and sands, and the preference for instruments of bronze, from its greater facility in being worked. Still, although only one iron mine has hitherto been discovered in Egypt, I am satisfied, from indications observed in crossing the Thebaid desert, that iron ore exists in several places among the rocks of that region. And, even supposing the ancient Egyptians to have been ignorant of the existence of iron ore in their own country; or unable, or unwilling to take the trouble of reducing it, yet the facilities of import from Phœnicia, Spain, Judæa, India, or the Grecian Archipelago, would be equally great with those of the import of tin, (used in the manufacture of bronze,) silver, spices, lapis lazuli, &c., and of the emery, corundum, and diamonds supposed to have been employed in cutting and polishing stones. I have also little doubt that the number of implements of iron and steel was small, and their use restricted to purposes for which bronze would prove inadequate.

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[1] Arundelian Tables.

[2] Genesis, iv. 22.

[3] Numbers, xxxi., 22; Deut., iii. 11.

In quarrying alabaster, gypsum, and the softer varieties of sandstone and limestone of Egypt, of which the pyramids and its earliest monuments are constructed, tools of bronze would be sufficiently hard. These rocks, like the Indian laterite, and some of our own freestones, though soft, and often chalklike in the quarry, exhibit a tendency to harden on exposure. The circumstance of a bronze chisel having been found in the limestone quarries at Thebes, strengthens this supposition. Another reason for the rare discovery, at the present day, of ancient tools, whether of bronze or iron, used in quarries and other out-door work, may be found in the depredations committed both by strangers and the inhabitants of the soil, during a series of revolutions and ages.

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[1] *Ancient Egyptians*, 1st Series, Vol. III., p. 247.

Granites of India and Egypt.

Many of the granites of India resemble closely, in lithological character, the varieties found at Syene. Its red type is found in the granite of Severndroog, which is composed of fine crystals of red and rose-coloured felspar, combined with dark brilliant scales of mica, transparent quartz, and a few interspersed crystals of hornblende. Such is the granite composing most of the obelisks, and many of the colossi of Egypt. The compact, grey, fine-grained, and hornblendic granites, skirting the red granite of Syene, all have their types in the rocks of Mysore and the Ceded Districts. The red varieties in both countries appear to be the least laminar, and not so easily affected by fire.

Processes of Polishing.

The exquisite polish, for which the granites, greenstones, and basalts of Egypt have been so much admired, is equalled, if not excelled, by the lustre of those of India, particularly in the mausolea of Golconda, the ruins of Bijanugger, Gulberga, and in many of the temples interspersed throughout the Nizam's dominions, the Ceded Districts, Mysore, Coimbatoor, Salem, the Carnatic, and Tanjore. For producing this polish, I have seen two processes practised by the Hindus.

In the first, a smooth, heavy piece of granite, or greenstone, of a flattish cylindrical shape, is armed on its under side, which is slightly hollowed out for the purpose, with a mixture of powdered corundum, and the common lac previously melted. This adheres, in cooling, very strongly to the stone, which is then fixed firmly between two flexible sticks, whose extremities uniting at either end form a double handle, by which the stone is worked, backwards and forwards, over the surface of the slab to be polished, which has been previously slightly smoothed. Water is occasionally sprinkled, to diminish friction, and to prevent the lac from being heated and sticking to the slab. The polishing stone is usually worked by two men or women, sitting opposite each other.

In the second process, to which they have recourse in polishing idols, cornices, mouldings, and other objects of sculpture, where nicety of adaptation is necessary, pieces of wood of different sizes and shapes, armed with the preparation of corundum and lac, are used with water, and not unfrequently lumps of the preparation itself without the wood. The corundum powder in each lump is of a different degree of fineness. They commence first with the coarsest,—using the finer as the polish advances. The manner of applying them with the hand upon the surface of the image, and the shape and size of the polishing blocks themselves, were recalled forcibly to mind by the sight of some paintings at Thebes representing several Egyptian sculptors in the act of polishing a sitting colossal statue of granite[1]. Corundum and emery have not hitherto been found in situ in Egypt; the latter, as Sir G. Wilkinson observes, might have been imported from Naxos and Smyrna, and the former from India where it exists in great abundance in various parts of the Mysore and Salem districts, and still forms an article of export by the Arab and Moplay merchants to Ceylon and the Eastern Archipelago, chiefly for the purpose of polishing stones and gems[2]. In passing the desert that lies between the Red Sea and Thebes, I crossed a zone of gneiss associated with micaceous, and a talcose schist, resembling that which forms the gangue of this mineral in India: it is not therefore impossible that mines may have existed then, whose site is now lost.

Uses of Granite.

Some of the purposes to which the Hindus apply granitic rocks, have been adverted to in the course of this paper. Granite, greenstone, basalt, and a dark talcose rock, are preferred by them for their altars, images, and phallytic emblems. The Jains, however, evince a strong predilection for images of metal and white marble. A singular instance of the preference of the Hindus for granite, in the construction of their temples, occurs amid the ruins of Bijapore, a city built almost entirely of the brownish purple amygdaloid of the surrounding secondary trap formation. Here the only structure of granite visible, is an old massive Hindu pagoda, whose ponderous granite rafters must have been brought at least from a distance of twenty miles through heavy cotton ground.

The granite caryatid pillars of the temple of Viddya Vittel, amid the ruins of Bijanugger, a sacred city entirely built of this rock, and abounding with colossal statues of the same material,—some from nine to seventeen feet high,—present a mass of deep and elaborate carving, unequalled by any specimen of sculpture I witnessed in Egypt.

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[1] Vide WILKINSON'S *Ancient Egyptians*, 1st Series, Vol. III., p. 336.

[2] Vide my account of the Corundum pits in Mysore, published in the Journal of the Madras Branch Royal Asiatic Society for January, 1840.

Granite Monolith Colossi.

The granite monolith colossus to the Jaina Saint, Gomúta Raya, at Sravan Belgola in Mysore, exceeds in height any similar known colossal statue of granite in Egypt. It is seventy feet three inches high[1], and stands on an elevated rock, from which it has apparently been cut, a conspicuous landmark to the surrounding country. I was unfortunately prevented by the superstition of the Jaina priests who accompanied me from making accurate measurements of the proportions of this gigantic statue. It is entirely divest of drapery, in an erect position facing the north, and has the curly hair, large disproportionate ears, and thick lips almost peculiar to the Jaina statues: of the latter feature, and the expression of calm, placid repose prevading the whole, I was powerfully reminded in examining the head of the younger Memnon. The legs are wreathed with the leaves and tendrils of a parasitical plant,—the Ratimulla,—and, together with the hands, are clumsily executed. The granite is rose coloured, resembling that of Syene, but of finer grain. There is another granite colossus to the same personage at Carculla, in Southern Canara; the extreme dimensions of which above ground, are thirty-eight feet in height, and ten feet in thickness. It bears a date equivalent to A. D. 1431[2].

The largest discovered statue of granite in Egypt is that dedicated to Rameses II., which lies prostrate and broken, in the Memnonium at Thebes; though not so large as its Indian rival, it claims greater attention, from the circumstance of its having been transported to its present position, at least one hundred and thirty-six miles from the quarry. This merit it possesses, in common with many other Egyptian colossi and monolith temples, over those of India, which are generally hewn and left in situ. The great Sphynx, it may be observed, en passant, is hewn from a soft calcareous rock in situ, and is said[3] to be one hundred and forty-three feet long, and sixty-two feet high from the belly to the summit of the head. But to return to our subject:—the statue of Rameses was so much broken as to preclud accurate measurement of its extreme dimensions; but judging from the proportions of the parts still remaining, (though this is by no means an accurate criterion in either Hindu or Egyptian sculpture,) I should think that its extreme height could not exceed fifty feet, if so much: as the statue was originally in a sitting posture like the two sandstone Memnons in the plain, whose height Sir G. Wilkinson[1], states at forty-seven feet.

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[1] HAMILTON'S *Gazetteer*, Art. "Sravana Belgula."

[2] *Ibid.*, Art. "Canara South."

[3] Pliny. xxxvi. 12.

The breadth of the statue of Rameses between the shoulders I found to be twenty-two feet three inches[2]; the length of the ear about three feet; and the length of the second toe, including the nail, on the remnant of a fractured foot, two feet ten inches, the girth round the chest is between sixty-two and sixty-three feet.

Monolith Temple of Granite.

In alluding to the monolith temples of the Hindus, I shall not mention those of Ellora, Elephanta, or Carli, being excavated from rocks generally much softer than granite,—viz. an amygdaloidal trap and wacke,—but proceed at once to give an idea of the magnitude and extent of the singular monoliths at Mahabalipur, on the Coromandel coast. As it is not the object of this paper to enter into any relative comparison of the details of Egyptian and Hindu sculpture, I shall confine myself almost entirely to the points just mentioned. Mahabalipur, or the Seven Pagodas, is a range of rocks extending along the Coromandel coast in lat. 12° 36′ N. and long. 80° 16′ E., and scattered irregularly over an area of nearly two miles long, and three-quarters of a mile broad. They are composed of a hard grey granite containing quartz, mica and felspar, with a few crystals of hornblende interpersed. Many have been hollowed out by art, and sculptured into temples adorned with spirited bas-reliefs,—representing episodes in Hindu history and mythology,—and supported by graceful columns,—all carved from the solid rock. Detached masses have been cut into the shapes of elephants, tigers, lions, &c., and colossal statues of gods. Mr. Goldingham found the southernmost of these temples about forty feet in height, twenty-nine in breadth, and nearly the same in length;—the exterior covered with elaborate sculpture. The next is about forty-nine feet in length; in breadth and height twenty-five feet: it is rent by natural causes, from summit to base. According to the local Brahmanical tradition, these interesting sculptures were executed by four thousand workmen, who had emigrated from the north, and returned before their completion. From a careful examination, it is evident that almost all of the enormous mass of sculpture and carving that adorns this city of monolith temples and colossi, must have been performed without the assistance of fire—with the hammer, chisel, lever, and wedge alone: and this is one of the hardest rocks in the world ![1]

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[1] *Ancient Egyptians*, 1st. Series, Vol. III., p. 320.

[2] Sir G. Wilkinson's measurements are as follows: "Its foot exceeds, in fact, seven cubits; and to judge from the fragments, must have have been about eleven feet in length, and four feet ten inches in breadth. The statue measures from the shoulder to the elbow twelve feet ten inches, twenty-two feet four inches across the shoulders, and fourteen feet four inches from the neck to the elbow." (*Thebes*, p. 10, Note.)

The largest existing monolith temple of granite in Egypt is that of Tel-et-mai, on the Delta. It is twenty-one feet nine inches high, thirteen feet broad in front, and eleven feet seven inches deep on the exterior[2]. That of Amasis, if we may believe Herodotus, nearly equals those of Mahabalipur in magnitude,—measuring outside the roof, twenty-one Greek cubits in length, fourteen in breadth and eight in height. It was brought from Elephantine to Sais,—a distance of twenty days' navigation. Two thousand men were employed three years in transporting this immense mass . Another, still larger he mentions as standing at Buto, at the Sebennytic mouth of the Nile, in the fane of Latona, forty cubits in height[4].

Pillars and Obelisks.

The ancient Egyptians far excelled the Hindus in the grandeur and number of their monolith pillars and obelisks of granite. Most of the proudest specimens of the former have been scattered abroad among the nations of Europe,—lasting records of their fame,—and with the deeply-cut hieroglyphics that cover most of them, the wonder and admiration of the world. The largest now stands in front of Rome's most magnificent Christian temple,—the Basilica of St. Giovanni Laterano. Another too, I contemplated rising in stately haughtiness amid the mosques and minarets of the great metropolis of Islam, Stambool; whilst a third decorates the gayest place of the gayest city in Europe, Paris. Its companion I had left in desert loneliness, a solitary sentinel still keeping its post in front of the great propyla at Luxor, amid the vast wreck of Jove's hundred-gated city scattered around. The total number of known Egyptian Obelisks (which, with few exceptions, are granite monoliths) is estimated at forty-two, twelve lie prostrate, and only eight out of the number now remain in Egypt[1],—singular vicissitude! though hardly to be lamented, when we consider the fate to which many of Egypt's glorious monuments have been consigned in their native land,—a fate from which the Elgin marbles were snatched, and one from which the liberality of the British nation is about to rescue many of the lately explored and interesting antiquities of Asia Minor. Twelve of the Egyptian obelisks are of the colossal order: the largest—the Lateran—is one hundred and five feet seven inches in height: its weight, about four hundred and forty tons. The Hindus, as far as my observation extends, are unacquainted with the obelisk: the plan of that erected by them near Seringapatam, to the memory of Josiah Webbe, was furnished by Europeans. It is composed of a single block of granite from sixty to seventy feet high, with a base six feet in diameter. Their inscribed pillars or *Laths* are usually cylindrical. Some of the *Gúrda Kámbhas* in front of the pagodas are octangular granite shafts often forty feet high.

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[1] Mahabalipur is supposed to be identical with the commercial emporium of Maliarpha, mentioned by Ptolemy in his 7th Book. Both Roman and Chinese coins have been found in the vicinity. A recent letter, dated August last, from my friend Mr. Norton of Madras, announces the discovery of a number of ancient coins on the spot made during a visit in which he accompanied Lord Elphinstone to this singular city in the early part of the same month. One he mentions, of Valentinianus, as quite distinct.

[2] *Ancient Egyptians*, 1st Series, Vol. *iii.*, p. 331.

[3] Herod. II., 175.

[4] Ibid., II., 155.

Bridges, &c. of Granite.

Many bridges have been constructed by the Hindus of enormous blocks of granite placed upright at certain intervals, supporting slabs of the same rock laid horizontally upon them. Such was the bridge that crossed the Tumbuddra, at the ruins of Anagundi. That crossing the northern branch of the Cauvery, near Seringapatam, is composed of three rows of square granite pillars, each row comprising sixty-seven pillars, and each pillar a single block of granite, connected by cross beams of the same material, over which others are laid transversely. The bridge traverses the river in a winding direction, and is altogether a rude but striking specimen of native art. I did not observe any ancient bridges in Egypt of granite or other material. Both Hindus and Egyptians were acquainted with the arch. The celebrated arch of Saccara, and the imitations of arches at Thebes, have their counterparts in the granite walls, and in the passages up the Vimána of the great temple at Bijanugger; but arches were not applied by the Hindus to the construction of bridges.

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[1] Bonomi on *Alnwick Obelisk.—Lit. Gazette*, 1245, p. 771. Note.

[2] *Ibid.*

With regard to the first introduction of granite for the purposes of sculpture, we may refer it, probably, both in India and Egypt, to a period subsequent to the discovery of iron and steel, the use of the softer rocks,—such as limestone, laterite, sandstone, and others easily workable with tools of bronze,—a metal confessedly of more ancient date in the history of metallurgy than iron. Granite, on account of its great durability, has rivalled marble in the distinction of being selected by the most enlightened nations upon earth, to assist in the commemoration of great events, to extend the power of priestcraft, or to hand down to posterity the glory of demigods, sages, kings, and heroes.